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ABSTRACT

Computer education in developing nations has been proceeding quietly and on a limited scale, but it has been progressing. An overview of computer education in developing nations is presented, and an annotated bibliography is offered to inform researchers that computer education as it relates to a developing country's social, economic, and political development is an area that needs attention. Most documents about computer education in the developing countries are descriptive and lack in-depth analysis. The 93-item bibliography is based on a search of electronic databases, including ERIC. Items are arranged by across-continent, across-country, and country in alphabetical order. Subject classification is not provided, given the fact that regional unit is most relevant to comparative studies. (SLD)

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Computer Education in Developing Countries: analysis and an annotated bibliography

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## Introduction to the bibliography

Computers are widely used in schools in industrialized countries. The research on computer education in developed countries is rich in both quantity and variety. While developed countries continue to expand and improve the use of computer in schools and research attention continue to focus on computer education in developed countries, Third World countries have quietly implemented and expanded their computer education programs in limited scale. Yet, there is little research conducted to relate computer education to social, economic, and political development in developing countries. The lack of research effort is reflected by the quantity and contents of studies included this bibliography. A overwhelming amount of research focuses on the use of computers as classroom teaching tools such as computer-assisted instruction for teaching math, science, arts, distance education, and special education in developing countries. Research related computer education to societal changes is scarce.

This annotated bibliography attempts to inform researchers that computer education in developing countries is an important research area that needs research attention. It also hopes to provide concerned researchers with an idea about the shape and the nature of the literature, and therefore, to facilitate further research in this area.

This bibliography is based on the search of a number of electronic databases including ERIC (1966-8/1/1994), Education Index (6/1983-7/28/1994), Dissertation Abstract (Jan. 1861-Dec. 1993), and Illinet Online, a statewide library system, which consists of 700 libraries in Illinois and 36 out-of-state libraries and provides bibliographic information on holdings records of these libraries. Since some journals are covered by both ERIC and Education Index, there are overlaps between them. These overlaps were eliminated.

Wilson (nine combined), SocialFile, and PsychLit databases were also searched, but given the nature of these databases, the number of relevant items were extremely small.

Since many items are conference papers and some of them do not have information on publication place and publisher, ERIC accession numbers were provided so that the reader can access the items through ERIC microfilms.

Items in this bibliography are arranged by across-continent, across-country, and by country in alphabetical order. Items that cover countries across continents such as countries in Asia, Africa, and Latin America are included in the continent category. Items that include a number of countries such as China, India, and Thailand are arranged in across-country category. Studies deal with only one country are included in by country category.

Given the small number of items and that regional unit is most relevant to comparative studies, subject classification is not provided.

# Adding a New Dimension to Research in Comparative Education : Computer Education in Developing Countries

Lewis-Guodo Liu

Social Scientists such as educationists, economists, political scientists, sociologists, historians, and anthropologists who are concerned with education and societal changes have made tremendous efforts in studying education and its relationship to social, economic, and political changes in developing countries. These efforts are largely reflected by various forms of publications compiled in Altbach, Kelly, and Kelly's *International Bibliography of Comparative Education* (1981); Kelly and Kelly's *Women's Education in the Third World: an annotated bibliography* (1989); Altbach et al.'s *Research on Foreign Students, and International Study: an overview and bibliography* (1985); *Foreign Students and International Study: bibliography and analysis* (1989); and numerous field review articles by Kelly and Altbach (1986); Kelly (1987); and Altbach (1991), which appeared in the Comparative Education Review. In fact, the field of comparative education covers a great variety of issues related to education and societal changes. It is not exaggerating to say that comparative education researchers have explored almost every research avenue related to education and societal changes.

Yet, surprisingly, comparative education researchers have been completely mute to the impact of computer education on societal changes in developing countries. This is evidenced by the fact that there have not been any research articles on this subject published in any of the major comparative education journals including Comparative Education Review, Comparative Education, Compare, and International Review of Education in past decades! There was only a two-page note by Shah (1989, p. 349) on computer education in India published by International Review of Education in 1989.

Comparative education has a long tradition of describing educational practices such as various education systems and programs, government educational policies, educational goals in other countries. Yet we rarely ask basic descriptive questions such as: What does computer education look like in developing countries? What are government policies toward computer education in developing countries? What are computer education programs available in developing countries? What are the rationales for computer education in developing countries? What kinds of efforts have been made to develop computer education by developing countries? What are the problems associated with computer education in developing countries? How to deal with these problems? What are positive or negative experiences gained in computer education by developing countries?

We are concerned about education and social equity and study race, class, ethnicity, and region differences in terms of educational access, process, and outcome. Yet we forget to discuss the role of computer education in these areas. We seldom ask questions related to these issues such as: Do different social, economic, religious, and regional groups have the same access to computer education in developing countries? Do students from various social and economic background follow the same learning pattern in computer training process?

We study education and economic development of developing countries. Yet we rarely ask questions such as: How computer education is related to national development? How people in developing countries are trained for various computer operations? Are trained computer professionals fully employed in the field for which they have been trained? Do developing countries have infrastructures to absorb computer personnel? What is the impact of computerization on employment in developing countries in general and the impact of trained computer professionals on employment in particular? To what extent should developing countries spend their limited resources on building their computer and information infrastructure and on developing their computer education programs?

We are concerned about education and women in developing countries, yet we rarely ask questions like: What is the impact of computer education on women? Do girls have the same access to computer education as boys? Do girls have the same interest in studying computers as boys? Do women with computer skills have the same employment opportunity as men in developing countries? If women are less or more interested in computers than men, what are the implications for women's participation in economic, social, political, and technological changes in developing countries?

We discuss dependency issues. Yet we rarely ask questions like: To what extent do developing countries depend on industrialized countries in educational hardware and software supplies? What are the advantages and disadvantages of importing hardware and software from industrialized nations? What are the short-term and long term gains and losses for developing countries? Do computerization and computer education help developing countries or hinder national development of the Third World? And to what extent?

We describe and analyze quality of education. Yet we have not made any efforts to study quality of computer education in Third World countries.

Computer technologies have a great impact on Western societies. Like telephone, telegram, television, and many other modern technological advancements, they shape people's way of thinking, living, and working. Computer technologies are widely used in

the field of education in industrialized nations. But do computer technologies and computer education have the same impact on the Third World?

While computer education in developing countries is ignored by comparative education researchers, there is a small body of literature on this subject (approximately 100 items) covering some of the questions listed above. To date, there is only one book discussing computer education in developing countries (Hawkridge et al., 1990b). This book addresses some basic questions such as whether or not computer education is needed in the Third World; software, hardware , and training issues; and describes computer education practices in some developing countries. The overwhelming majority of the studies have been conducted by researchers who are not in the field of social sciences. They tend to look at computer education in developing countries from classroom perspective, and rarely explore the subject with respect to social, economic, and political changes in developing countries. Furthermore, the studies on this subject are scattered among three dozens of various journals and conferences, indicating the lack of organized efforts on this research topic. Most of the studies are descriptive in nature and lack of in-depth analysis.

This essay reviews and analyzes the literature of computer education in developing countries in the past decades and points out the areas to which research attention should be given. It attempts to inform researchers that there is little research that relates computer education to social and economic development of the Third World.

## Early efforts in the 1970s

Since the invention of the microprocessor in 1971 by the Intel Corporation and the introduction of inexpensive personal computers by Apple Computers in 1977, the use of computers has begun to spread in schools in the United States and other industrialized countries although the use of computers in education started much earlier. While the applications of computers to schools in developing countries started in the early and mid of the1980s, the concern on computer education in developing countries initiated as early as the beginning of the 1970s. The issues covered include economic development, computer technology transfer, and computer-assisted instruction.

## Computer technology and computer education for development

The assumption that computer technology plays a significant role in economic development of developing countries was widely accepted by both Third World and international organizations. The demand for training computer professionals was voiced at the United Nations meeting of the Ad Hoc Panel of Experts on Computer Technology held

in February 1970. Rajaraman (1970) discussed the needs for training computer scientists for India's economic development and called for applying computers into areas such as research and development, education and training, and engineering. Rajaraman held that computers play a role in industrialization of developing countries. Bussel (1972) argued explictly that developing countries need computer education for development, and further pointed out that developing countries should be cost-effective in developing computer education given insufficient financial and human resources. In the fifteenth session of United Nations Economic and Social Council held in 1971 in Geneva, the Advisory Committee on the Application of Science and Technology for Development raised issues regarding the application of computer technology in developing countries including employment, curriculum development, management, and trade barriers such as customs regulations which may impete hardware and sofware transter. The issues discussed by the Advisory Committee were largely reflected in the report by Secretary-General in 1975, which identified the needs for the use of computers for economic development in developing countries and the needs for international cooperations in the field of computer technologies, and recommended computer training and education in developing countries.

Computer technology transfer

Computer technology was developed in industrialized countries. To introduce computer technology to developing countries, various organizations and programs, particularly international institutions were needed to carry out that transfer. Many papers prepared for United Nations and Unesco in the early 1970s addressed issues related to computer technology transfer and computer education in developing countries. A few papers prepared for the United Nations examined the role of international organizations in computer technology transfer. Fagbemi (1970) discussed the role of the United Nations in transferring computer technology to developing countries. Olinto (1970) looked at how international agencies could assist computer science education in Latin America. Bennett (1970) discussed how computer skills were transfered to developing countries through training students from Southeast Asia by Australian universities and problems associated with it. In 1976, an article discussed the possibility of computer education technology diffusion from an industrialized society into developing one by creating necessary ingredients (Searles and Rizza, 1976).

While most of discussion on computer technology transfer focuses on utilizing international organizational resources, some authors looked at how developing countries can do for themselves. Rodriguez (1970) looked at private indigenous industry as an alternative for developing computer education currricula and providing the computer skills in Latin

America. Kesavan (1970) discussed the preparation work needed by developing countries for computer technology transfer from donor countries in the context of India. Some looked at how developing countries learn from computer education experiences in industrialized countries such as the United States (Boehm, 1972). One of the lessons was to avoid training narrowly-oriented computer technicians.

Computer-assisted instruction

The concept of computer-assisted instruction for schools in developing countries was introduced as early as 1970. A Unesco's report (1970) discussed the application of computer educational technologies into schools including computerizing courses, teacher training needed for computer-assisted courses, the possibility of transferring learning materials from industrialized countries such as from the United States. Searles and Rizza (1978) studied the use of computer-based education in Brazil. Phythian (1973) studied the use of computers in teaching mathematics. However, given the fact that almost all the developing countries did not start computer education yet in 1970, the literature on this topic was scarce. Most studies on computer-assisted instruction in developing countries started and expanded in the 1980s.

In the late 1970s, the research started examining issues related to the use of computers in education, and the impact on employment (Nilsen, 1979), computer applications in educational administrations such as registration, instruction, examination, and evaluation in developing countries (Rizza and Searles, 1978).

The literature on computer education in developing countries in the 1970s was not only small in scale, but also descriptive in nature, and unevenly distributed. The research only focused on certain countries. For example, Searles and Rizza's studies only focused on Brazil. This was because computer education at that time was at its beginning stage in some countries, and had not started yet in many other developing countries. The 1980s witnessed the growth of computer education programs in developing countries, and the moderate growth of the research.

Research in the 1980s

Many developing countries started integrating microcomputers into school curricula in the early 1980s and the mid of 1980s, and expanded computer education thereafter in terms of quantity and variety. As more computers were applied to education, the literature on computer education in developing countries increased moderately and covered a variety of issues and can be summarized into the following categories:

-government initiatives toward computer education such as campaigns for computer education, computer education programs such as computer literacy program

-computers used as tools for instruction of math and sciences, distance education, handicapped education, language learning, programming

-computer applications in education administration

-rationales for computer applications in education

-cooperation between developed and developing countries in computer education

-students' attitudes toward the use of computers

-computer education and national development needs

-computer education and dependency

-problems related to computer education including language problem with computers operation; culture and computer education, lack of infrastructure, teacher training problems, hardware and software

Government initiatives

As computers become more widely used in society, governments in developing countries started taking initiatives in computer education in the hope to improve quality of education and accelerate national development. Asia and the Pacific Program of Educational Innovation for Development (APEID) organized a few seminars on educational technologies at the early 1980s. The third seminar held in 1984 exclusively discussed computers in education in Asian and the Pacific countries including China, India, the Philippines, Sri Lanka, and Thailand. Papers presented by country representatives covered a variety of issues related to computer education including government initiatives, policies toward computer education, and computer education programs, and problems associated with it. Individual authors such as Nag (1988) and Shah (1989) also described Computer Literacy and Studies in Schools (CLASS) a campaign initiated by the Indian government for computer education. Azinian (1987) described government 's policy toward and efforts in computer education in Argentina.

Computers used as tools for instruction

Overwhelming number of articles discussed the use of computer as instructional means. This branch of literature focuses on how computers can be used to improve instruction (Zhang, 1986; Kow, 1982; Rao, 1982; Harper, 1985); science and math education (Talisayon, 1989); education for the handicapped ( Fakhro, 1988; Osguthorpe et al., 1988); teachers training (APEID, 1988); computer literacy (Austin and Lutterodt, 1982), and distance education (More et al., 1988; Distance Education Report in Guyana).

While most of authors believe that computers contribute to learning positively, Reggini (1983) argued that computers will not contribute to any significant improvement in learning if educators do not understand cognitive learning process.

Computer application in education administration

Computers are widely used in education administration at all levels in industrialized countries such as the United States, and there is a great deal of research on this topic. But few studied the use of computers to improve the efficiency of education administration in developing countries. Selim (1983) discussed a computer algorithm for solving problems related to course and lecture timetables at the American University in Cairo. Kumsa (1990) looked at the use of an education management information system and computer technology to improve the data and information provision and retrieval.

Rationales for computer applications in education

As more efforts were made in expanding computer education in developing countries, quantity and quality of computer education programs were improved, and the literature of computer education increased, researchers began to conceptually looked at the rationales for developing computer education in developing countries. According to the literature under review, there is a general consensus by researchers from both developing and developed countries on the reasons for computer education in developing countries.

First, computers are widely used in manufacturing (such as automobiles, electronic products) and services (such as government administration, airport control, hospitals, banks and other financial institutions) in industrialized countries and some developing countries, there is a need for training young people with basic computer skills called computer literacy.

Second, computers have been approved to be effective tools to assist students in learning other subjects such as math and sciences, languages, and arts. Many items in the literature focus on computer-assisted learning.

Third, computers can be used to improve educational and administrative efficiency in schools.

Fourth, computer education is linked to national development of developing countries

Fifth, it is argued that information is important for development. The use of computers facilitate access to information (Smith, 1989, p. 170)

Some even argue that computer education in developing countries is needed for research and development (Rajaraman, 1970).

Hawkridge (1990a) summaried rationales for computer education in developing countries as follows: social rationale: students need to prepare for and function in a society with new technologies; vocational rationale: students need to be proficient in technical and professional fields; pedagogical ratinale: computers can be used to improve learning and instruction; and catalytic rationale: the use of computers in schools can bring about other changes including improvement of school efficiency, students' ability in problem-solving and team work.

Cooperation or dependency

Governments of developing countries often view technologies as instruments for national development. There is no exception for computer technology. To be able to utilize computer technology, people must have computer skills. Computer education plays an important role in providing people with such skills. While some developing countries such as China (Makrakis and Liu, 1993), India (APEID, 1985), and Brazil (Machado, 1985) have been trying to develop their indigenous computer industries, and software programs, many other developing countries have to import hardware and software and technical support. But given the lack of infrastructure of computer industry, computer knowledge, and scarce financial resources, developing countries are not able to produce sophisticated computer hardware and software and train teachers needed to carry out computer education. The alternative is to cooperate with the West. The literature reflects these practices.

A few articles discuss the cooperation between developed and developing countries in computer education. Shaker (1980) described how Americans helped Saudi Arabia to integrate computer-assisted instruction into the indigenous curriculum without imposing American culture, and argued that the American multicultural ideology can be applied to international arena. The discussion on this topic continued in the 1990s. For example, Richardson (1990) encouraged such cooperation between the United States and China and maintained that Chinese schools will benefit from educational technology from the United States. Dong (1993) discussed the portability of "electronic workbench" package, a simulation software package made by Canada, to China and its usability in Chinese schools and universities.

While the benefits from the cooperation between the developed and developing countries were observed, some authors raised the question of whether increasing applications of computer technology is used as a tool for national development or as a tool for dependency. Makrakis and Liu (1993) argued that unless developing countries have well-defined goals and policies toward indigenization, and make efforts to develop

indigenous new information technology infrastructure, computerization would lead to more dependency (p.35). They observed that China had made active efforts to develop indigenous computer hardware manufacturing and software development.

Machado (1985 ) described the efforts made by the Brazilian government in establishing its own computer industry to reduce dependency on industrialized countries. Machado argued that the national computer industry can survive only if development of human resources is kept up with it. Based on the interview with the decision-makers from industry, education, and the National Congress, Machado found that the majority of the respondents favored the policy toward protecting indigenous computer industry.
Others such as Hawkridge (1990) argued that in the short-run, developing countries may need the help from developed countries and dependency may be necessary. But in the long-run, as developing countries have established their own industrial, information, and computer infrastructure, developing countries can be independent.

It is the author's opinion that the development is a process.
Short-term dependency is inevitable. It is not realistic for the Third World to start building their computer industries and computer education programs from scratch , and is not a wise alternative. Solely relying importing computer technologies from the West to facilitate national development may impede the growth of indigenous industry, and which in turn may hinder national development. The cooperation between developing and developed countries is a necessary step for developing countries to eventually become less dependent. It is unclear that in a competitive global economic environment, developing and developed worlds can be completely independent of each other. Interdependency may be the future trend.

In the 1990s

While research on computer education in developing countries in the 1990s continue to address the issues that were addressed in the past decade such as national development and computer-assisted instruction, researchers tend to look at the issues in depth and beyond computer and classroom teaching. Researchers began to relate computer education to variables outside classroom and addressed the dilemmas faced by developing countries such as maintaining indigenous culture while using imported computer programs; expanding computer education programs with scarce financial resources; importing hardware and software while developing indigenous computer industries to support computer education programs.

Preserving indigenous cultures and using imported computer educational programs

In 1976, Searles and Rizza studied the possibility of diffusing computer educational technology from a developed country into a developing economy by creating some ingredients which are nonexistent in the developing country. In the 1990s researchers began to look at preserving indigenous cultures while utilizing imported computer educational programs. Palmer (1990) points out that while developing countries provide courses in computer literacy in the hope of preparing students for the information age, caution should be given to maintaining the cultures of indigenous countries since computers are language-based devices and may enhance or degrade or eliminate cultural elements of a society. Palmer called for strengthening teachers' role in computer education and using multicultural computer software.

Students' attitude toward the use of computers and gender difference

Another new trend in computer education in developing countries in the 1990s is that researchers began to study the attitudes of students toward the use of computers (Jegede et al., 1990; Ainsa, 1993; Miller and Varma, 1994). Jegede et al. examined whether or not there is a change in students' attitude toward implementations of computers in science teaching. They found that such attitude change occurs as a result of interactive use of computers. Miller and Varma examined the variables such as computer experiences and anxiety and their effects on Indian children's attitudes toward computers. They found that the effects of the factors under investigation are significant. A study conducted by Ainsa explored the relationship between the educational level of Mexican parents and their attitudes toward the education and computer training for their children in Mexican schools.

The attitude study also was related to gender differences. Jegede et al. (1990) found the girls had more positive attitude toward the use of computers than boys in learning biology. This finding is opposite to the findings in the United States where girls were found to be less interested in the use of computers (Smith, 1989). Garland and Yang (1994) observed, when conducting a computer-learning workshop for training the Chinese teachers and educational administrators, that men participants had more involvement in computer education than women, and had more opportunities to use dBASE III. Women used more word-processing and men, and men used more statistical package and managerial software than women (p.53).

While researchers discussed the advantages of the use of computers in education, they also discussed the problems associated with it. The problems are summarized and discussed as follows.

lagging behind

Since the emergence of personal computers, the use of computers has begun to spread in schools in the United States and other industrialized countries. In recent years, microcomputers for student instruction in public elementary and secondary schools had 19.2 students per microcomputer ratio and 16.5 for private schools in the United States (U.S. Bureau of the Census, Statistical Abstract of the United States;1993, p. 165). In developing countries, computers are scarce resources because of the following reasons:

-lack of manufacturing capability in general
-lack of computer technologies ( hardware and software)
-lack of hardware and software maintenance capability
-lack of computer knowledge infrastructure
- limited financial resources
-lack of trained computer teachers,
-language difficulties

lack of manufacturing capability in general

One of the characteristics of developing countries is the lack of manufacturing capability. Indigenous industries as a whole are weak and imbalanced. Some developing countries have one or a few sophisticated industries and are capable of manufacturing one or a few industrial products, but not able to produce anything in other industrial areas. This imbalance makes production of computer hardware difficult since computer manufacturing technologies require sophisticated technologies in many areas such as metal, electronic, and plastic industries.

Lack of computer technologies in particular

Except that a few countries such as China, India, Brazil which are capable of manufacturing certain types of computers, many other developing countries simply do not have any computer manufacturing ability at all. The only alternative for them to implement computer education in schools is to import computers hardware and software from industrialized countries. But given scarce financial resources and limited foreign currency, it is impossible for developing countries to purchase computers with quantity they need and with quality they desire.

Lack of hardware and software maintenance capability

While computer hardware and software can be imported to the Third Word from the West, it is, to some extent, more expensive and difficult to maintain normal operation of computers, to repair broken parts, to provide technical consultation when technical problems arise. Third World countries cannot afford to hire a number of foreign consultants sitting there, waiting for the problems to occur. Serimis (1987) described computer operation problems such as frequent power failures and lack of transmission medium for connections among campuses in a higher education institution in Honduras.

Lack of computer knowledge infrastructure

Universities and research institutions in many developing countries in general either do not have computer science departments or have not kept up with closely the development of computer technologies in industrialized countries. Their knowledge on computer education is also limited since little research has been done in this area. Quite often schools look for technical help from universities and research institutions. If universities and research institutions know little about the subject, it is difficult for schools to implement computer education, particularly in the large scale.

These generic problems and other country-based unique problems in one way or another slow down computer education process in many developing countries.

Teacher training

One of the important area in computer education in developing countries is teacher training since the computer education is relatively new field of learning, and the lack of instructors and equipment to train computer teachers. It was the problem in the 1970s (Sadowsky, 1970) and the problem in the 1980s. To cope with this problem, Asia and the Pacific Programme of Educational Innovation for Development (APEID), Unesco regional office organized a regional teachers training workshop in 1985 aiming at exchanging the experiences in teacher training among some Asian countries including Bangladesh, India, Indonesia, Malaysia, the Philippines, Sri Lanka, and Thailand. In1988, APEID organized a seminar specifically introduced the Unesco complete teacher training package covering teacher training structure, content and methods, and training package, multi-media training package in computer education for teacher educators including a number of modules such as interacting with a computer, programming, word processing, database, spreadsheets, computer and society, and teaching with computers, and guidelines for computer education teacher training development.

A number of authors included the issue of teacher training in computer education as part their discussion (Grunberg, 1987; Baouendi and Wilson, 1989; National Institute for Educational Research, 1990; Chen, 1988; Azinian, 1987)

Language problem

There are problems associated with importing computer educational programs which are designed for the use in schools in the West to developing countries. The use of computer programs from the West imposes language problems for those countries whose languages are different from English. A numerous Chinese educators (Zhang,1986; Liu, 1987; Zhu, 1988) pointed out that the Chinese characters are different from English alphabetic letters and difficulties in processing Chinese characters in computer applications, and described the efforts made to solve these problems. In fact, in many non-English speaking countries, using computer education programs designed for children in English-speaking countries can be problematic. For example, to be able to use Logo programming language whose command language is English-based to write a computer program, one needs to understand the basic English language vocabularies. Although it is not impossible to teach basic English words, it adds complexity to the learning process and financial burden to schools, particularly when English teachers are not available.

Summary and conclusion

It can be summarized and concluded that the size of the literature in computer education in the Third World is small: approximately 100 items. A larger portion of the items is unpublished conference papers and reports. Many of studies were done by educators and researchers of developing countries. And there were only a few published books on computer education in developing countries. The published articles are scattered among various journals, indicating that there is a lack of systematic study on this subject. Overwhelming majority of items are descriptive, and lack of in-depth analysis. Little research has been done on computer education with respect to social and economic development. Most of the items are concerned with classroom teaching. The literature also reflects that some international organizations make great efforts to sponsor conferences and make it possible for developing countries to exchange ideas and experiences, and discuss problems such organizations include Asia and the Pacific Program of Educational innovation for Development (APEID), a Unesco regional office, which sponsored numerous conferences for Asian countries, and the United Nations.

The studies on computer education in the Third World are unevenly distributed among countries and regions. There are many more studies on China than any other

countries. And many of them were done by Chinese researchers. This is largely because China has a larger number of schools and research institutions and more active computer education programs. This unevenness also exists among regions. While there is more research attention to Asian and Latin America, studies on Africa and the Middle East are very limited. This reflects the uneven development in computer technologies and computer education among regions.

Future research

The purpose of this essay and the bibliography is to inform researchers who are concerned with education and development in developing countries, particularly researchers in the field of comparative education that there is a lack of effort in studying computer education and its impact on social, economic, and political development of the Third World. We have been witnessing that computer technologies shape people's way of thinking, working, and living in industrialized nations. We need to look at such an impact on developing countries, and start rethinking of old problems within new contexts. The current literature does not give us much clue to whether or not and to what extent expanding computer education can help social and economic development of Third World countries and related issues because previous research has not been able to relate computer education to societal changes in developing countries. Future research should focus on studying computer education with respect to social, economic, and political aspects of developing countries.

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*those items cited in this article but not included this bibliography are listed in the annotated bibliography.

Computer Education in Developing Countries:
an annotated bibliography
Lewis-Guodo Liu

## ACROSS CONTINENT

Akinyemi, K. "Micros and Children in Developing Countries." *Programmed Learning and Educational Technology* 23, no. 2 (May 1986) : 173-76.

Describes the computer education experiences in primary and secondary schools in Nigeria, Morocco, and Argentina including national and institutional policies and campaign for computer education, program development, and teacher training.

Austin, Gilbert R.; Lutterodt, Sarah A. "The Computer at School" *Prospects: Quarterly Review of Education* 12, no.4 (1982) : 421-438.

Discusses alternative uses of computers in schools of developing countries including issues related to computers used as tools for instruction and computer literacy education.

Boehm, Barry W. "National Degree of Computerization: A context for Evaluating Computer Education Policies in Developing Countries." 1972. ERIC ED 071 424

Suggests that the Third Word should not repeat problems faced by the United States by studying various stages of computer development. One of the lessons is to avoid training narrowly oriented computer technicians.

Bussel, Claudia. "Computer Education for Development." Proceedings Based on the Rio Symposium on Computer Education for Developing Countries. August 6-12,1972. ERIC ED 071 706.

Argues that developing countries need computer education for development. Points out that developing countries should be cost-effective in developing computer education given insufficient financial and human resources.

Fagbemi, O.J. "Skills in Relation to Educational Background." Paper prepared for the United Nations Meeting of Ad Hoc Panel of Experts on Technology held in New York, NY. February, 1970. ERIC ED 055 597.

Examines the role of the U.N. in transferring computer technology and skills from developed to developing countries.

Hawkridge, David et al. "Economics, Education and Computers in Third World Schools." Paper presented at the International Conference on Technology and Education (7th). Brussels, Belgium, March 20-22, 1990a. ERIC ED 346 836.

Discusses the issues related to computer uses in some developing countries including China, Kenya, Jordan, Mauritius, Sri Lanka, Tunisia, and Zimbabwe based on the information provided by teachers and policy-makers of these countries. Examines the rationales for computer education including social, vocational, pedagogical, and catalytic rationales. Raises the question of dependency and unequal education in computer education in developing countries.

Hawkridge, David et al . *Computer in Third World Schools* New York: St. Martin's Press. 1990b.

The first book that discusses computer education in developing countries. Addresses basic issues such as why computer education is needed in the Third World, and hardware, software, training, and dependency issues. Also covers computer education experiences in some developing countries.

Nilsen, Svein Erik. "The Use of Computer Technology in Some Developing Countries." *International Social Science Journal* 31, no.3 (1979) : 513-528.

Describes the uses of computers in education and the impact on employment in some developing countries in Asia, Latin America, Africa, and the Middle East.

Oliveria, Jao Batista Araujoe. "Computer Education in Developing Countries: Facing Hard Choices." *Education and Computing* 4, no.4 (1988) : 301-311.

Discusses criteria for selecting computer technologies including instructional and cost effectiveness, demands on job markets, policies toward computer education, teacher roles, and curriculum development.

Palmer, Janet J. "Cultural Literacy and Computer Literacy: Cautions for the Third World.: Paper presented to the World Conference on Computers in Education. (5th). Sydney, Australia, July 9-13, 1990.

ERIC ED 331 496.

Points out that while developing countries provide courses in computer literacy in the hope of preparing students for the information age, attention should be paid to maintaining the cultures of indigenous countries since computers are language-based devices and may enhance or degrade or eliminate cultural elements of a society. Recommends strengthening teachers' role in computer education and using multicultural computer software.

United Nations Economic and Social Council, Advisory Committee on the Application of science and Technology for Development. Fifteenth session. "The role of modern science and technology in the development of nations and the need to strengthen economic and technico-scientific cooperation among states" Geneva: (General Assembly resolution 3658) Note by Secretary of General. 15-26 November, 1971.

Expresses concerns that the report by the Secretary General would include issues related to application of computer technology in developing countries, curriculum development, trade barriers that may impede technology transfer.

United Nations Economic and Social Council. "The Application of Computer Technology for Development." Report of the Secretary-General. Prepared for the Forty-ninth session. 1975. ERIC ED 046 461.

Identifies the needs for the use of computers for economic development in developing countries and the needs for international cooperations in the field of computer technologies. Recommends computer training and education in developing countries.

## ACROSS COUNTRY

### Africa

Hawkridge, David. "Rationales and Futures for Computers in African Schools and Universities." CITE Report No. 100. Paper presented at the Workshop on Computers in Education. Kwaluseni, Swaziland, December 10-14, 1989). ERIC ED 328 482.

Examines rationales for and experiences in applying computers in schools and higher education in some African countries including Botswana, Kenya, Lesotho, and Zimbabwe. Questions the impact of computer uses in the future.

Pagano, Alicia I. "Urban Senegal and Rural Gambia: computer and community education programs." *Childhood Education* 62, (1986) :182-185.

Describes the use of computers in community education programs in urban Senegal and rural Gambia.

Programme of Action Proposed by the Director-General. "Priority: Africa." Lome, Togo, December 3-7, 1990. Proceedings of the Informafrica Seminar on Informatics in the Service of the Development of Education in Africa. ERIC ED 344 585.

Looks at the issues of applying computer technologies in education, research, and development in Africa including policy, strategy, computer software, maintenance, and problems.

Unesco. "Unesco Regional Meeting of Computer Centre Directors in Africa" Arusha, Tanzania, April 14-18, 1980. ERIC ED 227 820.

Discusses experiences and problems of applying computers in education and training in seven member states of Unecso in the African Region.

**Asia**

Asia and the Pacific Programme of Educational Innovation for Development (APEID) "Teachers and Their Use of Educational Technology." Report of a Regional Training Workshop. Seoul, South Korea, September 16-27, 1985. ERIC ED 291 349.

Reports the experiences of teachers in learning and using educational technology from Asia and the Pacific region including Bangladesh, India, Indonesia, Malaysia, the Philippines, Sri Lanka, and Thailand

Asian Programme of Educational Innovation for Development (APEID). Japanese National Commission for UNESCO. "Computers in Education: An Outline of Country Experiences." Report of the Asian Seminar on Educational Technology, 3rd. Tokyo, Japan, September 26-October 2, 1984. ERIC ED 272 149.

Reviews the issues related to the use of computer technologies in education, teacher training, business, and industry in Asia and the Pacific Region. Developing countries included are China, India, Malaysia, the Philippines, Sri Lanka, and Thailand.

Talisayon, Vivien M. "Computers in Science and Mathematics Education in the ASEAN Region." *Journal of Computers in Mathematics and Science Teaching* 8, no.3 (Spring 1989) : 35-42.

Describes the use of computers as an instructional means in science and mathematics education and regional cooperation in Brunei, Indonesia, Malaysia, the Philippines, and Thailand.

Asia and the Pacific Programme of Educational Innovation for Development (APEID). *Computers in Education: An outline of country experiences.* The Third Asian Seminar on Educational Technology held in the context of the Third Programming Cycle of APEID at the Tokyo Gakugei University, Japan, September 26- October 2, 1984. Unesco Regional Office for Education in Asia and the Pacific Bangkok, 1985.

Presents the brief history of computer education; government policies toward computer education; initiatives taken by government and research and business institutions to develop computer education and teacher training programs, and problems in Asian and Pacific countries including China, India, the Philippines, Sri Lanka, and Thailand.

Asia and the Pacific Programme of Educational Innovation for Development (APEID). "Report of The Asian Seminar on Educational Technology", 4th. Tokyo, Japan, October 10-19 1985. ERIC ED 302 233.

Discusses the experiences of the Asian and Pacific countries in using microcomputers for teacher training.

Asia and the Pacific Programme of Educational Innovation for Development (APEID). *Training of Teachers in Computer Education:Teachnical Papers on Computer Education 1.* Unesco Principal Regional Office for Asia and the Pacific. Bangkok, December 1988.

Consists of three chapters. Chapter one discusses issues related to policies and objectives of computer education, profile of computer education teachers, teacher training structure, content and methods, and training package. Chapter two discusses the Unesco multi-media training package in computer education for teacher educators including a number of modules such as interacting with a computer, programming, word processing, database, spreadsheets, computer and society, and teaching with computers.

Chapter three discusses guidelines for computer education teacher training development.

National Institute for Educational Research (NIER) of Japan. "Tomorrow's Tools Today: The State of Educational Computing in Asia and the Pacific." A Report of the Regional Seminar. June 13-27, 1990. ERIC ED326 186.

Aims at sharing information in computer education. Examines the situation of computers in education in participating countries. Evaluates the research on policy, hardware, software, teacher training, and other related issues. Provides recommendations.

**Latin America**

Olinto, A.C. "Objective goals and role of international agencies in computer science education in Latin America." Paper prepared for the United Nations meeting of the Ad Hoc Panel of Experts on Computer Technology. New York: United Nations, 1970. ED 055 603

Discusses how international agencies can do to help computer education in Latin Amerian countries.

Rodriguez, F.L.T. "The role of the private sector in applying computer technology to the development of Latin American Countries." Paper prepared for the United Nations meeting of the Ad Hoc Panel of Experts on Computer Technology. New York: United Nations, 1970. ED 055 610.

Describes four phases of the data processing technology and the private industry involvement in developing computer curricula and training in Latin American countries.

Sadowsky, Manuel. "Computing and Education in Argentina, Uruguay and Paraguay" Background paper prepared for the United Nations meeting of the Ad Hoc Panel of Experts on Computer Technology held in February 1970. United Nations, New York, N.Y. ERIC ED 055 599.

Presents the facts and problems in computer education in three Latin American countries: Argentina, Uruguay and Paraguay such as

the number of computers installed and lack of trained computer teachers.

Unesco. "Project for Education in Latin America and the Caribbean." UNESCO Bulletin 14. 1987. ERIC ED 301 484.

Consists of a number of papers. Describes the role of computers in education. Observes the advantage of using computer-assisted instruction in assisting slow-learners. Evaluates cost-effectiveness of utilizing computers in schools. Examines the impact of computer education on employment opportunities for young people. Discusses the problems of obtaining computer equipment in developing countries.

### Middle East

Noor, A. El Sayed. "Computer-Based Information System Education in the Arab World." *Computers and Education* 7, no.2 (1983) : 109-120.

Reviews computer science education, computer engineering , computer-based management information systems in the Arab countries. Discusses factors that widen the gap between the Arab countries and industrialized countries.

## BY COUNTRY

### Africa

### Egypt

Selim, S. M. "An Algorithm for Producing Course and Lecture Timetables." *Computers and Education*. 7, no.2 (1983) : 101-108.

Discusses a computer algorithm for solving problems related to course and lecture timetables at the American University in Cairo.

### Ethiopia

Kumsa, Gabeyehu. "The Role of Information System for Education Planning and Management." Paper presented at the International Congress on

Planning and Management of Educational Development. Mexico City, Mexico, March 26-30, 1990. ERIC ED 328 285.

Describes the efforts made by Ethiopia's Ministry of Education to keep up with the development of information and computer technology. Discusses issues related to improving the data and information provision and retrieval through investment in an education management information system (EMIS) and computer technology. Suggests that computer related training programs should be established at educational institutions.

**Kenya**

Marcum, Beth A. " Network System Awakes Nairobi." *Computing Teacher* 21, (December 1993-January 1994) : 32-33.

Considers education and manpower needs in Kenya. Discusses computer science teaching and network in Nairobi.

**Nigeria**

Akinyemi, Kunle. "Compu-camp: Innovation n Nigerian Primary Education." *Media in Education and Development* 19, (March 1986) : 30-33.

Presents computer programming teaching activities in Nigerian elementary schools.

Jegede, Olugbemiro J. et al. "Attitude to the Use of the Computer for Learning Biological Concepts and Achievement of Students in an Environment Dominated by Indigenous Technology." Paper presented at the Annunal Meeting of the National Association for Research in Science Teaching, (63rd). Atlanta, GA. Aprial 8-11, 1990. ERIC ED 317 401.

Jegede, Olugbemiro J.; Okebukola, Peter Akinsola. "Adopting technology in Third World classrooms: students' viewpoint about computers in science teaching and learning" *Journal of Educational Technology Systems*. 20, no.4 (1991-1992) : 327-334.

Describes the use of computers in science teaching in high schools of Nigeria and the students' attitudes toward implementations of computers in science teaching.

Umerah, Gabriel Azuka. *Computer applications in developing countries.* Ed. D. Diss., Texas Tech University, 1991.

Argues that while computer literacy education in the United States started from bottom-up and without planning, developing countries should plan more carefully to avoid unnecessary costs. Focuses on developing a computer application model for teacher colleges in Nigeria's state. Studies the needs for and attitudes towards computer applications by looking at factors affecting computer applications and planning.

**Tanzania**

Phythian, J.E. "The Role of the Computer and Computer Associated Studies in Mathematical Education in a developing Country." *International Journal of Mathematical education Technology* 4, no.2 (April-June 1973) : 109-119.

Discusses the use of computers in mathematics education.

**Asia**

**Bahrain** (oil rich but not industrialized)

Fakhro, Samir Q. "The Use of Microcomputers in the Education and Training of Deaf Children in Bahrain: a Pilot Project." *Educational Media International* 25, (June 1988) :123-125.

Describes the use of microcomputers as aids in speech teaching for deaf children in Bahrain.

**Brunei** (oil rich but not industrialized)

Khine, Myint Swe. "Computers in Schools: The Issues, Problems, and Prospects." ERIC ED 344 568.

Questions whether computer education is necessary to meet social and economic needs of this small but oil-rich country. Observes that there were computer education activities in schools such as computer clubs, computer-assisted instruction classes, and the support from both teachers and educational administrators for computer education. Recommends a policy for computer education, teacher training programs, and the encouragement of existing computer education activities.

## China

Baouendi, Helene P.; Wilson, Judith D. "Computer Education in the Primary and Middle Schools in the People's Republic of China: The Late 1980's." *Education and Computing* 5, no. 4 (1989) : 275-286.

Examines the role of computer centers and institutes in computer literacy and teacher training. Reports the status of computer equipment and books and the development of instructional technology.

Chen, Qi. "Computer Education in Secondary Schools in The People's Republic of China. *Journal of Research in Science Teaching*. 25, no. 6 (September 1988) : 493-500.

Describes the history, instruction, teacher training, and evaluation of a computer programming course in China. Points out problems associated with the use of BASIC and Logo programming languages.

Cheng, Chao-Kun. "The Computer Science Program of a College in China." *Technological Horizons in Education* 14, no.5 (January 1987) : 64-66.

Describes a computer science program at the Harbin Shipbuilding Institute in China including required courses, computer facilities, and some observations.

Dong, Zhi-cheng; Collis, Betty. " The portability of the "electronics workbench" simulation software to China." *Journal of Educational Technology Systems* 22, no.2 (1993-1994) : 141-153.

Discusses the portability of "electronic workbench" package, a simulation software package made by Canada, to China and its usability in Chinese schools and universities.

Li, Jian-Jun. "A report on 'computer wizards' in China". *Educational Technology* 31, (February 1991) : 55-57.

Examines the factors that contribute to the computer programming skills of the young Chinese winners of the National Computer Programming Contest for Youth held in China. The positive factors identified are strong ambition, love for knowledge, ability for self-learning, some knowledge in several computer

programming languages, and a solid understanding of math and sciences.

Liu, Fengqiao."The Growing Influence of Microelectronics and Computer Technology in China." *Impact of Science on Society* 37, no.2 (1987) : 189-92.

Reviews the fast development of computer technologies in China. Discusses the increasing computer applications in business. Points out the difficulties of processing Chinese characters in computer applications and the problem related to computer software.

Garland, Virginia E.; Yang, David J. "East meets West: technology training in the People's Republic of China." *T.H.E. Journal* 21, (January 1994) :50-53.

Describes the current and future development of computer technology in education in China by examining the changes in computer technology in the Chinese schools between the1980s and the1990s. Discusses the computer training workshop for the Chinese teachers and educational administrators and the differences between men and women in computer training process.

Gubser, Lyn. "China Is Hungry for Educational Technology." *TechTrends* 31, no. 2 (February-March 1986) : 14-18.

Reports China's interest in the use of educational technology. Discusses nationwide educational goals and suppliers of computer hardware and software. Reflects the experiences of Association for Educational Communications and Technology officials who visited China.

Johnston, Jerome. "A Traveler's Notes. *TechTrends* 31, no.2 (February-March 1986) : 19-22.

Presents a view from a correspondent who visited six universities in China. Reports the use of television and computers in schools in China and potential market in China for computer hardware and software.

Maier, John H. "Computer Science Education in the People's Republic of China." *PTC Quarterly.* 7, no. 2 (June 1986). ERIC ED 274 311.

Observes that the number of China's higher education institutions is limited and that these institutions have limited capacity to train a large number of computer professionals needed in the future. Also observes that computer technologies have not penetrated many universities in China. Concludes that unless China's academic community plays a leading role in applying and disseminating computer technology to other sectors of economy and society, China's modernization goal by the year 2000 will not be possible.

Makrakis, Vasilios; Yuan-tu, Liu. "Informatics, Development, and Education: The Case of China." *Educational Technology* 33, no. 9 (September 1993) : 31-37.

Discusses issues related to computers and new information technology, computer literacy, educational software, teacher training, and information and national policies in China. Raises the question of whether information technology is used as a tool for national development or as a tool for dependency.

Osguthorpe, Russell T.; et al. "Introducing Computers in Special Education Programs in the People's Republic of China."*International Journal of Special Education* 3, no.2 (1988) : 177-184.

Presents a technical assistance project designed to train special educators in Beijing, China to use computer to help students with visual and hearing impairments, and mental retardation. Also describes computer hardware donation to the special education centers and the evaluation of the software introduced by American vendors.

Richardson, M. D.; et al. "Computer Technology: Bridging the Gap." Paper presented at the Annual Meeting of the USA/China Education Consortium, 1990. ERIC ED 345 326.

Examines the role of computer technology in China. Covers issues related to the current status of school administration, educational technology, educational television, and computer education. Observes the lack of the applications of computer technology in the Chinese schools. Recommends the development of partnership between USA and China to facilitate the use of computer technology in the Chinese educational system.

Steen, Lynn Arthur. "Undergraduate Mathematics Education in the People's Republic of China." Report of a 1983 North American Delegation. MAA Notes Number 3. ERIC ED 289 698.

Provides the observations and experiences of North American mathematics educators who visited China and exchanged ideas with Chinese mathematics educators and officials of the Ministry of Education. Discusses issues related to undergraduate curriculum, mathematics applications, computer science, mathematics examinations, and administration and personnel.

Su, Yun-Lin "Computer Science Education in China." *Education and Computing*. 4, no. 2 (1988) : 125-33.

Reports the development of computer science at universities and the selection of students in China. Outlines computer science curricula at both undergraduate and graduate levels.

Wan, Jiaro; Li, Zhongmin. "Educational Technology Research and Development in The People's Republic of China." Paper presented at the China Association for Foreign Language Instructional Technology. Qingdao, China, August 3-6, 1988. ERIC ED 304 087.

Reviews the history of educational technology in China from 1949-1966 and from 1976 to the present, training and research in educational technology. Discusses different research orientations from different institutions. Suggests five future research areas: remote education, expansion of television universities, design and publication of instructional courseware, computer-assisted instruction, and educational communications networks.

Zhang, Chuan-de. "Computer-Based Education in China." *Educational Technology*. 26, no.7 (July 1986) : 41-43.

Reports early and recent efforts in applying computer-based education to primary and secondary education in China. Points out the problems associated with Chinese characters in word processing.

Zhu, Zhi-ting. "BICODE, an Environment for the Development of Bilingual Audio Courseware." Journal of Educational Technology Systems 16, no.1 (1987-1988) : 7-16.

Describes the integration of Chinese language into an audio software application.

## India

Kesavan, H. K. "Computer Education in a Developing Country." Background paper prepared for the United Nations meeting of the Ad Hoc Panel of Experts on Computer Technology held in February 1970. ERIC ED 055 596.

Considers the necessity of preparation work including resources and administrative structures by Indian Universities for computer technology transfer from donor countries.

Khan, Emdad H.; Sharma, Anil K. "Implementation and Evaluation of Computer Science in an Indian Secondary School." *Computers and Education* 14, no. 4 (1990) : 343-55.

Covers issues related to the design of computer courses, computer literacy, finance, student selection, teacher training in a secondary school in Bahrain, India.

Miller, Fayneese S.; Varma, Narendra. "The effects of psychosocial factors on Indian children's attitudes toward computers." *Journal of Educational Computing Research* 10, no.3 (1994) : 223-238.

Examines the effects of computer uses, computer experiences, and anxiety associated with the use of computers on Indian children's attitudes toward computers. Finds that the effects of the factors under investigation are significant.

Nag, B. "Informatics Education in India: The CLASS Project For Secondary Students." *Technological Horizons in Education* 15, no.5 (December 1987-January 88) : 67-70.

Reports Indian's computer literacy campaign: the Computer Literacy and Studies in Schools (CLASS).

Nigam, S. B. L. "Training Implications of Technological Change in Manufacturing in New Industrial Countries: The Case of India. Training Policies Discussion" Paper No. 16. ERIC ED 309 272.

One of a series of case studies on government policies toward education, technical training, and computers.

Rajaraman, V. "Computer Science Education in Developing Countries." Paper prepared for the United Nations meeting of the Ad Hoc Panel of Experts on Computer Technology held in February 1970. ERIC ED 055600.

Considers the needs for training computer scientists for India's economic development. Calls for applying computers into areas such as research and development, education and training, and engineering. Argues that computers play a role in industrialization of developing countries.

Rao, K. Srinivasa. "Computers in Education." *Physics Education* 7, no.4 (January-March 1991) : 315-19.

Reviews the role of computers in education. Describes computer applications in Indian schools and the Computer Literacy And Studies in Schools (CLASS).

Shah, Beena. "Computer education in India." *International Review of Education* 35, no.3 (1989) :349-351.

Briefly describes the initiatives taken and policies and programs developed by the Indian government at all levels and various organizations to introduce computers into Indian schools.

**Indonesia**

Hornaday, Robert W. "Multicultural experiential learning: a computer simulation in Indonesia." *Journal of Education for Business* 68, (November/December 1992) : 105-109.

Presents a computer simulation in management in a Master Management Program in Indonesia. Identifies positive results and problems associated with cultural and language differences.

Agency for International Development (IDCA) "Indonesia: Microcomputer Applications for Education Planning and Management: A Modular Training Program." Washington, DC. Bureau for Research and Development; Ministry of Education and Culture (Indonesia). ERIC ED 357 425.

Provides the descriptions of the program which aims at improving efficiency of the current education management information system in Indonesia and education administrators' skills in information management at the provincial level by applying microcomputers to the system.

## Malaysia

Harper, Dennis O. "Computer Education for Developing Nations." International Council for Computers in Education, 1985. ERIC ED 290 465.

Reports a project consisting of three pilot computer-assisted instruction courses for secondary school teachers. Identifies the problems related to equipment repair, administration, and language of instruction. Summarizes successes of the project including teachers' positive attitudes toward the use of computers in classroom and teachers' computer competency developed from the training courses.

Mackintosh, Nelson. "Child Plus Computer Equals Cognition." *Journal of Science and Mathematics Education in Southeast Asia* 6, no. 2 (December 1983) : 13-16.

Argues that computing should be part of the elementary school curriculum in Malaysia and programming courses should be provided at this educational level.

Kow, Khoo Goh."Potentials of Computer Assisted Learning in Malaysian Schools." *Journal of Science and Mathematics Education in Southeast Asia* 5, no. 2 (December 1982) : 19-21.

Observes that relatively inexpensive microcomputers make it possible for Malaysian schools to apply microcomputers into classrooms. Reports the successes and the problems associated with computer-aided instruction.

Peng, Tan Choon. "Should Computer Studies and Computer Appreciation Courses be Introduced in Malaysian Schools." *Journal of Science and Mathematics Education in Southeast Asia* 5, no.1 (July 1982) : 8-11.

Identifies the potential problems associated with computer science education at secondary education level in Malaysia. Examines the French computer education experiences. Suggests that the relevant experiences should be drawn from the French experiment before the implementation of such a program in Malaysia.

Rao, A. Kanakaratnam; Rao, G. S. "A Pilot CAI Scheme for the Malaysian Secondary Education System." *Journal of Science and Mathematics Education in Southeast Asia* 5, no.1 (July 1982) : 12-17.

Considers the use of computer-aided instruction as a tool to solve some problems faced by Malaysian secondary schools.

Shahdan, T. S. Tengku. "Computers in Malaysian Schools: Current Developments and Future Plans." *Educational Technology* 33, no.9 (September 1993) : 48-52.

Describes the efforts made by the Ministry of Education of Malaysia, higher education institutions, and private organizations in applying computers into the education system of Malaysia.

**Philippines**

Palmer, Janet J. "Computer education in the Philippines" T.H.E. Journal 20, (January 1993) : 72-73.

Briefly discusses computer education in public and private schools at all levels and teacher training in the Philippines. Observes that private schools are better equipped with computers than public schools, and that computer instruction has not been integrated into the school curriculum. Identifies problems such as limited financial resources and the lack of software and trained teachers.

**Thailand**

More, George A. B. et al. "The application of a Computer-based Instructional System for Distance Education: Report of a Pilot study in Thailand." *Educational Media International* 25, (December 1988) : 251-159.

Reports the use of computers as an instructional tool in distance education at Sukhothai Thammathirat Open University in Thailand.

**Latin America**

**Argentina**

Azinian, Herminia. " The Impact of Technology on Argentinean Education" *Technological Horizons in Education*; 15, no. 5 (1987-88) : 81-84.

Discusses government's policy on and efforts in computer education in Argentina. Includes issues related to informatics and

education, computer literacy, teacher training in computer techniques, and the social context of computers.

Pollitzer, Gustavo A. "Impact of Computers in Argentina, and the Attitude of Private Sectors, the Need for Professional Training, the Universities' Action, What Lies Ahead." Paper prepared for the United Nations meeting of the Ad Hoc Panel of Experts on Computer Technology, New York: United Nations,1970. ERIC ED 055 593.

Identifies the need for technological and professional management, administration, operation and planning. Provides basic facts including: 215 computers were installed in the country in 1970; and the annual installation rate was at 25%. But there was a severe shortage of trained computer personnel.

Reggini, Horacio C. "A Revision of Learning and Teaching Source" *Revista del nstituto de Investigaciones Educativas* 9, no. 43 (1983) :14-35. The Revista del Instituto de Investigaciones Educativas, Buenos Aires. ERIC ED 239603.

Reviews the recent cognitive science research on learning and teaching. Discusses the way in which science and mathematics are being taught. Analyzes how the presence of the computer demonstrates a need for rethinking of both the theory and the practice of learning. Points out that computers will not contribute to any genuine improvement in education unless educators understand the cognitive process through which students learn.

**Brazil**

Beatty, George, Jr. "The Design and Application of Information Systems in Higher Education." Paper presented at the International Seminar on Institutional Research, 1st, Campinas, Brazil, July 1976. ERIC ED140 692.

Describes the information systems developed for higher education institutions in the United States. Points out that data and systems requirements considerations must be based on national policies, coordination of the whole educational systems. Discusses possibilities that the American experiences in the field can be applied to higher education systems in Brazil.

Machado, Elian De Castro. Computer Education in Brazil: Policy Implementation Process as Seen by Various Stakeholders. Ph.D. Diss., Indiana University, 985.

Presents the fact that Brazil established its own computer industry to reduce dependency on industrialized countries. Argues that the national computer industry can survive only if development of human resources is kept up with it. Interviews the decision-makers from industry, education, and the National Congress and finds that the majority of the respondents favored the policy toward protecting indigenous computer industry. Identifies effective relationship between the computer industry and the universities and the lack of investment in research and development. Recommends computer education implementation should focus on secondary schools.

Rizza, Peter J. Jr.; Searles, John E."Feasibility Study in the Use of Computers in Non-Formal Education in Brazil." *Journal of Computer-Based Instruction* 4, no.4 (May 1978) : 84-92.

Reports computer applications in some instructional and educational administration areas such as registration, instruction, examination, termination, and evaluation.

Searles, John E.; Rizza, Peter J. "Computer Based Education for Developing Educational Systems." Paper presented at the Annual Meeting of the Association for the Development of Computer Based Instructional Systems, Dallas, Texas, March 1-4, 1978. ERIC ED161 416.

First study on the use of computer-based education in Brazil and Latin America.

Searles, John E.; Rizza, Peter J. Jr. "Cultural Diffusion of Educational Technology: Computer Based Education in Brazil." *Educational Technology* 16, no.11(November 1976) : 45-48.

Discusses the possibility of computer education technology diffusion into another culture by creating necessary ingredients.

**Chile**

Oteiza, Fidel L. "The Impact of Computer Technology on Schools in Chile." *Educational Technology* 33, no. 9 (September 1993) : 25-31.

Examines the impact of computers on Chilean education. Discusses issues related to Chilean educational system; the use of computers in private schools; leadership; socioeconomic

background of students; computer hardware and software, and computer programming languages.

## Ecuador

Palmer, Janet. "Computer Education in Ecuador: Preparing for a Competitive Future." *Technological Horizons in Education* 13, no.5 (January1986) : 103-104.

Presents Ecuador's experiences in getting technical consultation through an American agency for developing a computer education program in a school in Ecuador.

## Guyana

Distance Education in Guyana. Report of a Project Identification Consultancy. Consultant Report 3. ERIC ED 347 312.

Identifies the problems associated with the long distance education in Guyana. Points out that one of the effective tools to solve the problems is to use computers and other audio-video technologies including audio-teleconferencing, interactive videodiscs, and audio- video materials.

## Honduras

Shermis, Mark D. "Utilization of Computer Technology in the Third World: An Evaluation of Computer Operations at the University of Honduras." Paper presented at the Annual Meeting of the American Evaluation Association Boston, MA, October 15-17, 1987. ERIC ED 295 609.

Evaluates computer operations at the University of Honduras. Examines a number of problems such as lack of a back-up supported by the university for frequent power failure and telecommunications connections among its campuses. Recommends the development of a computer science program, expansion of the computer center, integration of data processing at the university level, and investment in computing hardware.

## Mexico

Ainsa, Patricia A. "Family Changes: An Extension of Young Children's Classroom Computer Interactions." *Journal of Computing in Childhood Education* 4, no.3-4 (1993) : 247-253.

Explores the relationship between the educational level of Mexican parents and their attitudes toward the education and computer training for their children in Mexican schools.

Reyes, Maria E.; Murray-Lasso, Marco A. "Administrative applications of computers to education in Mexico." *Journal of Research on Computing in Education.* 24, (Fall 1991) : 107-119.

Describes the use of microcomputers and software applications in the educational system of Mexico including spreadsheet, database managers, drawing packages, and communication software, and the fact that all the federal normal schools in Mexico are electronically networked.

**Uruguay**

Grunberg, Jorge. "Training Strategy: Computer Education for Teachers in Uruguay." *Technological Horizons in Education* 14, no.5 (January 1987) : 67-71.

Presents the Alfa Project aiming at integrating computer education as part of the secondary school curriculum in Uruguay. Discusses issues related to teacher training, course guidelines and objectives.

**Venezuela**

De Agostini Solines, Juan Carlos. "Use of Audio-Visual Materials in Teaching Computer Programming in Venezuela. "
*Educational Technology* 16, no.10 (October 1976) : 49-50.

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**Middle East**

**Iran**

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**Kuwait**

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**Saudi Arabia**

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Rebhun, Herbert F. "Teaching College Computer Courses in Saudi Arabia." Computer Information System, University of Houston-Downtown, Houston, Texas, 1991. ERIC ED 335 909.

Reports a teacher's experience in teaching college computer courses to the employees of the Saudi Arabian Customs Automation Department. Discusses issues related to different teaching methodologies such as problem-solving approach vs. rote

memorization approach; religious activities; English language as a means of instruction and a communication tool in the work environment; and the American business management practices.

Shaker, Paul. "Curriculum Change in the Developing Country: The Case of Saudi Arabia." Paper presented at the Annual Meeting of the American Educational Research Association (Boston, MA, April 7-11, 1980). ERIC ED 191 139.

Discusses that Americans help Saudi Arabia to integrate western technology including computer-assisted instruction into the indigenous curriculum without imposing the American culture. Argues that the American multicultural ideology can be applied in the international context.